

Practical 5: Water Body Mapping Using NDWI and Sentinel-2 Imagery in Google Earth Engine

Google Earth Engine is a cloud-based geospatial analysis platform developed by Google. It allows users to access a massive catalogue of satellite imagery, environmental datasets, and remote sensing products stored on Google's servers.

(a) ee – Earth Engine Python API

- Allows sending commands from Python to Google Earth Engine.
- Used for loading datasets, filtering by date, clipping, computing indices, etc.

(b) geemap – Interactive Mapping Library

- A Python package built on top of Earth Engine.
- Helps create **interactive maps**, similar to Google Maps or QGIS, but inside a notebook.
- Makes visualization easier by providing functions like adding layers, drawing ROIs, exporting data, etc.

Region of Interest (ROI)

A Region of Interest (ROI) is the specific geographic boundary where we want to perform analysis.

- Defined using longitude (x) and latitude (y) coordinates.
- Clipping satellite images to ROI reduces unnecessary data and speeds up processing.

Sentinel-2 Satellite Imagery

Sentinel-2 is a multispectral imaging mission launched by the European Space Agency (ESA).

Key features:

- 13 spectral bands (Blue, Green, Red, NIR, SWIR, etc.).
- High resolution: 10 m, 20 m, 60 m depending on band.
- Useful for land monitoring, vegetation analysis, water mapping, and disaster assessment.

NDWI (Normalized Difference Water Index)

NDWI is a spectral index used to identify and map water bodies such as lakes, rivers, reservoirs, and coastal waters.

NDWI Formula

$$NDWI = \frac{(Green - NIR)}{(Green + NIR)}$$

For Sentinel-2 imagery:

- Green band = B3
- Near Infrared (NIR) band = B8

Water surfaces reflect green light strongly and absorb near-infrared radiation, resulting in higher NDWI values.

Interpretation of NDWI Values

NDWI Value	Interpretation
NDWI > 0	Water bodies
NDWI ≈ 0	Mixed land cover
NDWI < 0	Urban areas, vegetation, soil

Higher NDWI values indicate a greater presence of water.

Visualization of NDWI

The NDWI result is visualized using a color scale:

- **Blue** represents water bodies
- **White** represents mixed surfaces
- **Brown** represents land areas

This thematic map helps in easy visual identification of water features.